the natural environment to his wants, and thus creates an environment for himself. Thus it is that we do not discover an aquatic variety of man; yet he dwells upon the sea, and derives sustentation from the animals thereof by means of his arts. An arboreal variety of man is not discovered, but the forests are used in his arts, and the fruits of the forests for his sustentation. An aerial variety of man is not discovered, but he uses the winds to propel his machinery and to drive his sails; and, indeed, he can ride upon the air with wings of his own invention. A boreal variety of man is not discovered, but he can dwell among the everlasting snows by providing architectural shelter, artificial warmth, and bodily protection.

Under the influences of the desert, a few plants secure a constitution by which the moisture imbibed during brief and intermittent rains is not evaporated: they become incrusted with a non-porous glaze, or contract themselves into the smallest space, and exist without life, until the rain comes again. Man lives in the desert by guiding a river thereon and fertilizing the sands with its waters, and the desert is covered with fields and gardens and homes. Everywhere he rises superior to physical nature. The angry sea may not lash him with its waves; for on the billows he builds a palace, and journeys from land to land. When the storm rises, it is signalled from afar, and he gathers his loved ones under the shelter of his home, and they listen to the melody of the rain on the roof. When the winds of winter blow, he kindles fossil sunshine on his hearth and sings the song of the Ingleside. When night covers the earth with darkness, he illumines his path with lightning light. For disease he discovers antidote; for pain, nepenthe; and he gains health and long life by sanitation; and ever is he utilizing the materials of nature, and ever controlling its powers. By his arts, institutions, languages, and philosophies he has organized a new kingdom of matter over which he rules. The beasts of the field, the birds of the air, the denizens of the waters, the winds, the waves, the rivers, the seas, the mountains, the valleys, are his subjects. The powers of nature are his servants, and the granite earth his throne.

INFLUENCE OF FORESTS UPON THE CLIMATE OF AUSTRALIA.

IN connection with the discussion that is going on at the present time in reference to the influence of forests upon rainfall in the western parts of the United States, the following remarks of Dr. R. von Lendenfeld on the influence of deforestation upon the climate of Australia, which were published in the February number of *Petermann's Mitteilungen*, will be of interest. The influence of the forest upon the climate in the damp regions of the temperate zone, for instance in central Europe, is undoubtedly such as to increase the humidity of a place. The roots of the trees, forming a network, retain the earth on steep slopes, and thus prevent the water from running off rapidly. On slopes without forest or vegetation the water rushes downward: it is collected in streamlets and rivers, and carried into the ocean before much, if any, evaporation has taken place.

Evidently a great part of the rain falling in a wooded country is evaporated before it can flow off, as the roots of the trees retard its collection in brooks and rivers. Lendenfeld has made some preliminary computations which lead him to the conclusion that about twenty-five per cent of the rain falling in wooded regions of the temperate zone, such as central Europe, are due to the influence of the forest. A country grown with grass and herbs would also have more rain than one in which the bare rocks were exposed to the air.

In Australia the influence of the forest is entirely different from what it is in Europe. The views of those Australians who are principally interested in this matter are divided. The general opinion is that the climate is becoming dryer in consequence of deforestation. Others, however, maintain that the cutting-down of the woods has no influence whatever upon the climate, and that, if such an influence should exist, it is so small as to be of no account, compared to the advantages connected with the deforestation. The latter view is principally held by squatters and ranchmen, who, of course, have an immediate interest in the opening of forest-land for agricultural and stock-raising purposes, and who cannot be expected to be unbiassed.

Australia is a very dry country, its northern portion alone being exposed to tropical rains. Besides this, only the south-eastern part is mountainous, which has elevations exceeding six thousand feet in height. These elevations — the Australian Alps — materially increase the amount of rain, and thus cause the great productivity of the colonies of New South Wales and Victoria.

Setting aside the Alps and the east coast, the whole of Australia is very dry. The interior is almost rainless; and even near the coast, in the greater part of New South Wales and Victoria, the amount of rain is very small, and does not reach the height of eight inches, while the evaporation amounts to ten feet. In the interior, rain is very rare, occurring only once in a period of about three years. In countries where long-continued droughts prevail, such plants as grow in humid regions cannot live. All plants of the desert, and among them the trees, shrubs, and grasses of the steppes of Australia, have certain means for increasing the water-supply from the deeper layers of the soil (i.e., roots extending to great depths), and others for diminishing evaporation. The *stomata* of many *Eucalypti* are removed from the surface of the leaf, and those of the *Spinifex* of the deserts are protected by a peculiar arrangement. Leitgeb, who has studied the movability of the cells of the *stomata*, found that they close the aperture the more, the less the water at the disposal of the plant.

Besides these well-known facts, Lendenfeld observed that the *stomata* of the leaves of *Eucalyptus* are perfectly closed whenever a hot and dry wind is blowing, so that in such cases no evaporation to speak of takes place. Therefore the same wind which is so dangerous to grasses and herbs has almost no influence whatever upon the *Eucalyptus* trees. Furthermore, Lendenfeld concludes that probably most plants of the desert have their *stomata* closed during the day-time, while they are open during the night. It is only then that carbonic acid enters the plant, and is dissolved in the sap. In the morning they close the *stomata*, and assimilation begins under the influence of the light. The carbonic acid dissolved during the night is decomposed, and the oxygen escapes through the epidermis.

It has been shown by Volkens, that during the latter part of the night the atmosphere, even of the desert, is to a greater or less degree saturated with vapor: therefore the plants do not lose much water by opening their *stomata* at night.

Almost all trees and shrubs of the interior of Australia produce ethereal oils in great quantities. In evaporating, it lessens the temperature of the leaves, and forms a layer of vapor all over the forest. According to Tyndall, air saturated with ether is less permeable for radiant heat than ordinary atmospheric air: thus the tree protects itself by means of a cover of ether from excessive heat and evaporation. As the leaves of the *Eucalyptus* trees turn their edges towards the sun, the effect of insolation is very slight. Thus it is shown that the trees and shrubs of the arid parts of Australia are well equipped to resist the dryness of the climate.

But, besides these plants, numerous small grasses and herbs occur, which Lendenfeld, following Volkens's example, calls ephemeric. They are not at all protected against evaporation. Their roots do not penetrate the soil to any great depth, and their *stomata* are open in the day-time. As their seeds are spread all over the ground in great quantities, they grow up rapidly after every rainfall, and cover the bare ground with a fresh green. They are the principal food of the sheep.

As long as water remains in the upper layers of the soil, the ephemeric plants grow. As soon, however, as the stock of water is used up, they die, as their roots do not extend deep enough. The roots of the trees spread from ten to fifteen feet below the surface of the ground, and absorb all the humidity of these layers which otherwise would gradually reach the surface in consequence of capillary attraction. Thus they prevent the stock of deep water from supplying the needs of the grasses.

In all temperate and humid countries the struggle of the plants is for light. In the interior of Australia, and in other similar subtropical regions, they struggle for water. Thus the ephemeric plants are here killed by the trees, and in wooded countries they do not occur at all.

Lendenfeld, while travelling through the wooded parts of Australia for days and days, did not observe a single blade of grass. The soil, which consisted to a great extent of red clay, was smooth as asphalt pavement, and hard as rock. Rain, when falling on such soil, does not penetrate it, but runs off rapidly. The low-lying regions are inundated; but it appears that the water is not evaporated there, but flows through subterranean channels into the ocean. There are no rivers with large watersheds in Australia. Even the largest river, the Murray, is navigable only in winter and for light steamboats.

The water runs off so quickly that it has hardly time to penetrate the hard and smooth ground. The woods, therefore, do not increase the humidity of the soil and of the air.

In many places the squatters begin to cut down the trees, so far as the laws permit their doing so. The local effect is marvellous. Lendenfeld observed that so many kinds of grasses began to grow, that on the same space on which, before the cutting-down of the trees, only one hundred sheep could be raised, a thousand found sufficient food.

This effect is brought about in the following way. As the trees do not absorb the humidity of the deep layers of the ground, it reaches the surface and is absorbed by the grasses. The decaying stems of the grasses form small channels in the soil, which lead to larger ones that were formerly occupied by the roots of the trees. Thus the ground becomes permeable for water. When rain falls, it runs off slowly, as the grasses hinder its movements. It penetrates the ground, and thus a greater portion of the total amount of rainfall benefits the spot at which it falls. Part of it evaporates, and thus increases the humidity of the air.

It has been said that the springs become more numerous by the cutting-down of the woods, as the grasses do not use the humidity of the deeper layers of the ground. Lendenfeld, however, maintains that the increase of water carried by the springs is not as great as the increase of water retained in the soil through the action of the grasses, and that a great part of the water of springs is evaporated, and increases the humidity of the air.

From all these facts, Lendenfeld concludes that in Australia the effect of deforesting the country is not a decrease, but an increase, of rainfall.

NEW ZEALAND LETTER.

THE long-continued commercial depression under which this colony still labors affects every class of the community, and is working a quiet, but in some respects much-needed, revolution in the habits of the people. There is no doubt that the colonists in former years had no ideas of economy in any direction; but these are now being forced on their notice in all sorts of ways. Early in last session of the Colonial Parliament, the Stout-Vogel ministry was overthrown, and Major (now Sir Harry) Atkinson assumed the reins of office, under strict pledges to enforce retrenchment in every possible direction. As far as the public can judge, these pledges are being fulfilled fearlessly and without favor.

In matters educational the primary-school system and the University of New Zealand come directly upon government for assistance. The former is altogether, and the latter to a considerable extent, dependent upon the annual appropriations made by the legislature. Considerable reductions have been made in the amount allotted for primary schools; but, as is so often the case, these reductions have not been effected in perhaps the best directions. Thus it was considered advisable to contract the school age at one or both ends. At present it commences at five years of age, and it was proposed to raise it to six. This would have disposed of the charge so often brought against the infant classes, especially of country schools, that they are merely convenient nursing-depots, where the younger children of a family are kept warm and out of mischief for a great part of each day. But the House of Representatives, in their wisdom, saw fit to retain the school age at five, but to knock off the highest or seventh standard. In times of depression, when it is difficult to find occupation for either old or young, it is commonly noticed that boys who have completed their sixth standard work are sent adrift to loaf on their parents, who cannot get them any work to do. For such a class alone, it would have been economy to keep the upper standards open, even had a small fee been charged. No education is so bad as that of the streets and of enforced idleness.

Another possible and profitable source of retrenchment in this much-overgoverned community would have been the abolition of some of the smaller education boards. It seems absurd, that, with a small population of some six hundred thousand, there should be something like twelve education boards, each with its paid staff of officials, — secretary, inspectors, etc. The abolition of at least six of these would have made a substantial reduction in the education vote: but, as it would have weakened or endangered the position of many of our precious representatives, it was not even considered, but, instead, the training-colleges at Auckland and Wellington were abolished; so that no adequate provision now exists in the North Island for the education of teachers. The free, secular, and compulsory system of primary education of this colony is one of the things the community is proud of, but it is a decidedly retrograde step when provision for adequately training its teachers is not made.

Secondary school education is all carried on in specially endowed schools, governed mainly by separate boards, and practically independent of the education department. Private enterprise in this direction is so handicapped by the endowments, that, except in a few cases of very special class schools, there are no private schools in the colony. A determined effort is made by a certain section of politicians to capitalize all these endowments for the benefit of the colony, and especially of primary education, and thus make secondary education dependent upon the support it might receive from those classes most able to provide it. Such a measure, if carried into effect, would close the avenues of the higher education to the poorer classes; while at present, owing to the low fees charged at the high schools (averaging from $50 to $62.50 per annum), and to the liberal provision made for scholarships, every boy or girl of promise in the primary school has a good chance of continuing his or her education in higher subjects at the public expense. While the secondary schools have not, in most cases, been retrenched directly, yet, as the revenues from their endowments have in nearly every case fallen considerably, the salaries of all their teachers have had to be correspondingly reduced.

The teaching of science occupies a very fair place in the curricula of New Zealand schools. In the primary schools very little is attempted beyond a few lessons in physics, physiology, or chemistry in the higher classes of the better schools. But alongside of this, rather heavy demands are made upon teachers going up for their examinations. Indeed, some knowledge of so many science subjects is demanded of them, that this part of the examination for classification defeats its own object. Were each teacher permitted to select one or two branches of science, and were they expected to attain a fairly high standard of efficiency in it, the introduction of really good science-teaching in the schools would soon follow, and indeed could be demanded.

In the secondary schools, provision of a kind is usually made for teaching one or two branches, although in only two schools in the colony is there a science-teacher who is a specialist. In most cases one of the staff is selected for his knowledge of some scientific subject; while the head master, being nearly always a classical scholar, does not, as a rule, attach a very high value to this department of school-work. This, however, is counterbalanced to a great extent by the importance which the New Zealand University attaches to science in its junior scholarship examinations, whose requirements constitute in many cases the guiding lines of the curricula of the high schools. For example: at the examination held last December, out of 60 candidates, 12 offered in botany, 26 in chemistry, 11 in mechanics, 14 in heat, 6 in electricity, and 1 in sound and light; that is to say, that, as each candidate who took science had to select any two subjects, 35 had offered themselves in this section of the examination. Most of the schools have either a small laboratory or at least a small stock of materials for teaching chemistry and some elementary physics, but little or none for the more specialized branches of the latter.

It is difficult for one not acquainted with the actual standards attempted, and the results gained, in schools of other countries, to compare the work done in our educational establishments with that done elsewhere. At the same time it is a fact that the medi-